

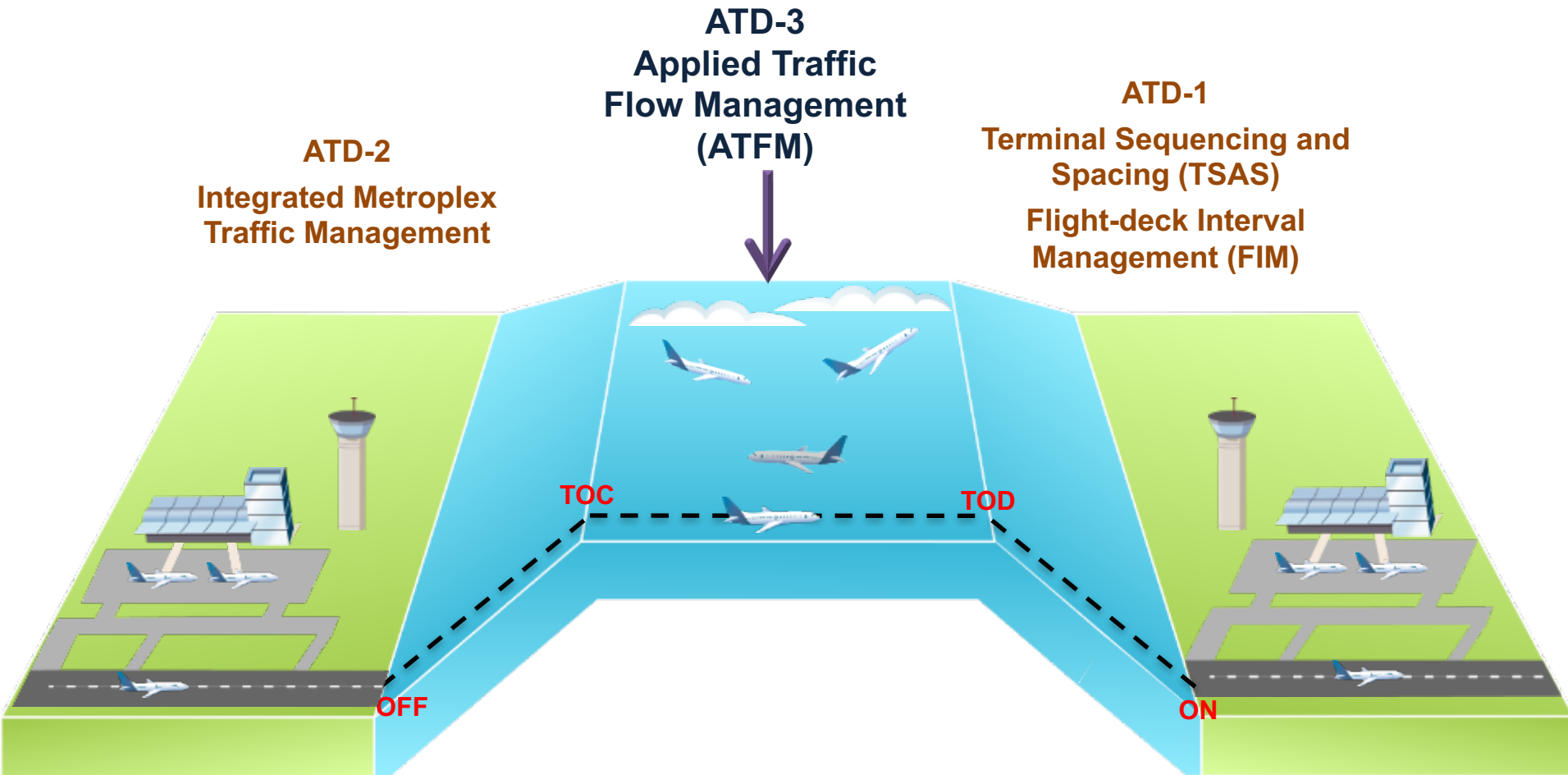
Airspace Technology Demonstration 3 (ATD-3): Applied Traffic Flow Management

Project Overview

October 24, 2016

Chester Gong
NASA Ames Research Center

ATD-3 Scope

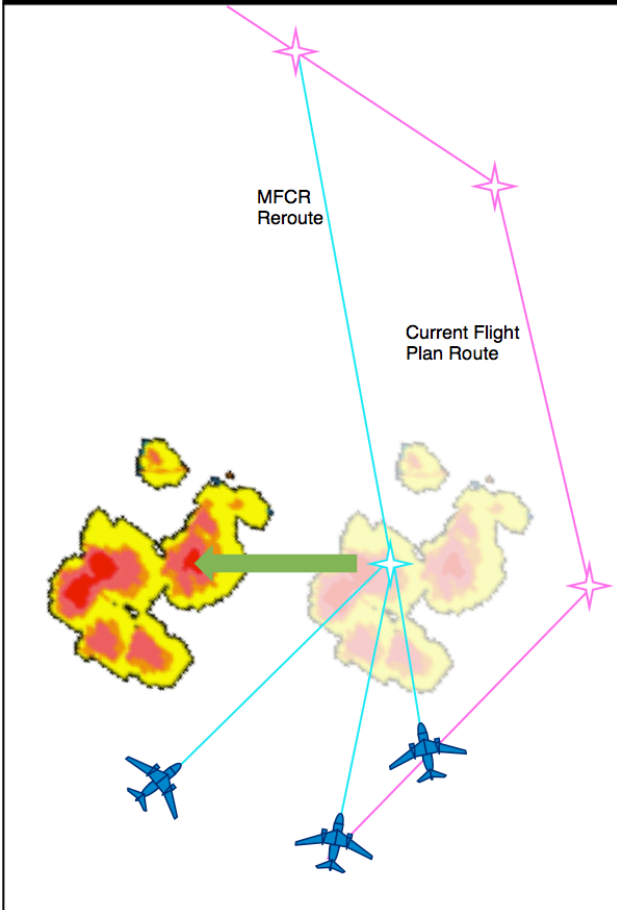


TOC - Top of Climb
TOD - Top of Descent

Reduce weather-induced delays through integration of weather information to better manage aircraft, traffic flow, airspace and schedule constraints by delivering air/ground procedures and user-tool technologies.

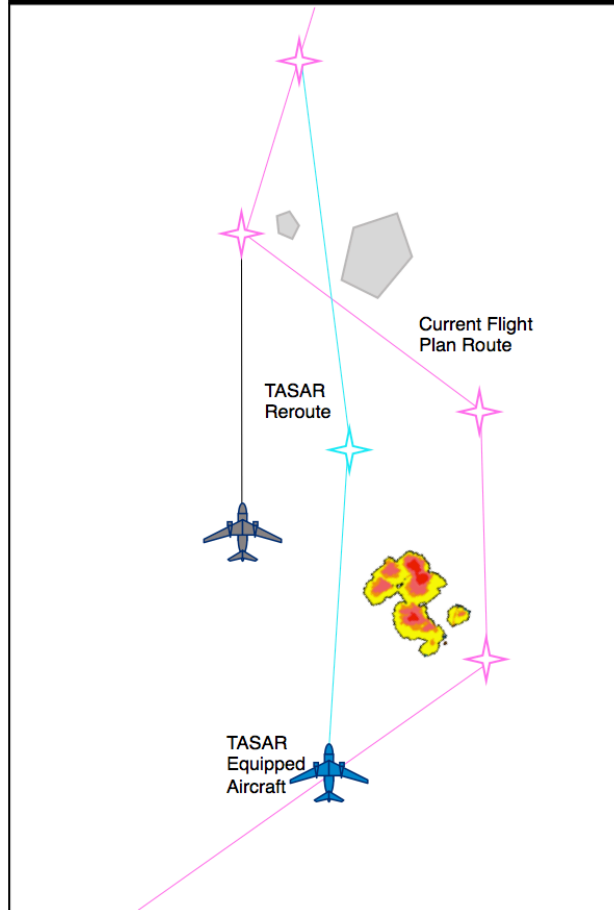
Multi-Flight Common Route (MFCR):

Automated search for efficient high value reroutes for individual flights and common reroutes for multiple flights - delay recovery from stale TMLs.



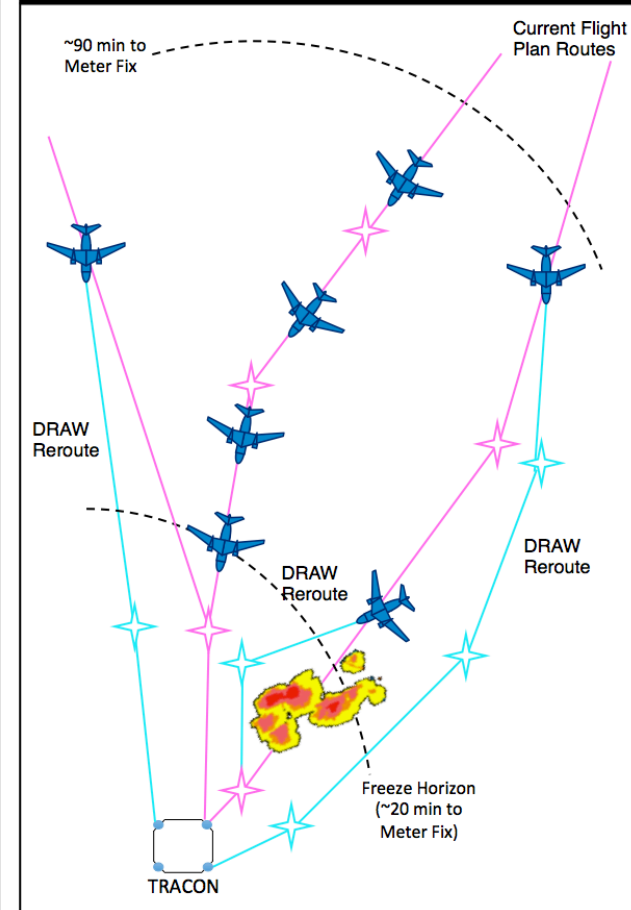
Traffic Aware Strategic Aircrew Requests (TASAR):

Airborne automated continuous searching for efficient reroutes that reduce fuel and/or flight time, avoid interactions with traffic, weather and restricted airspace.

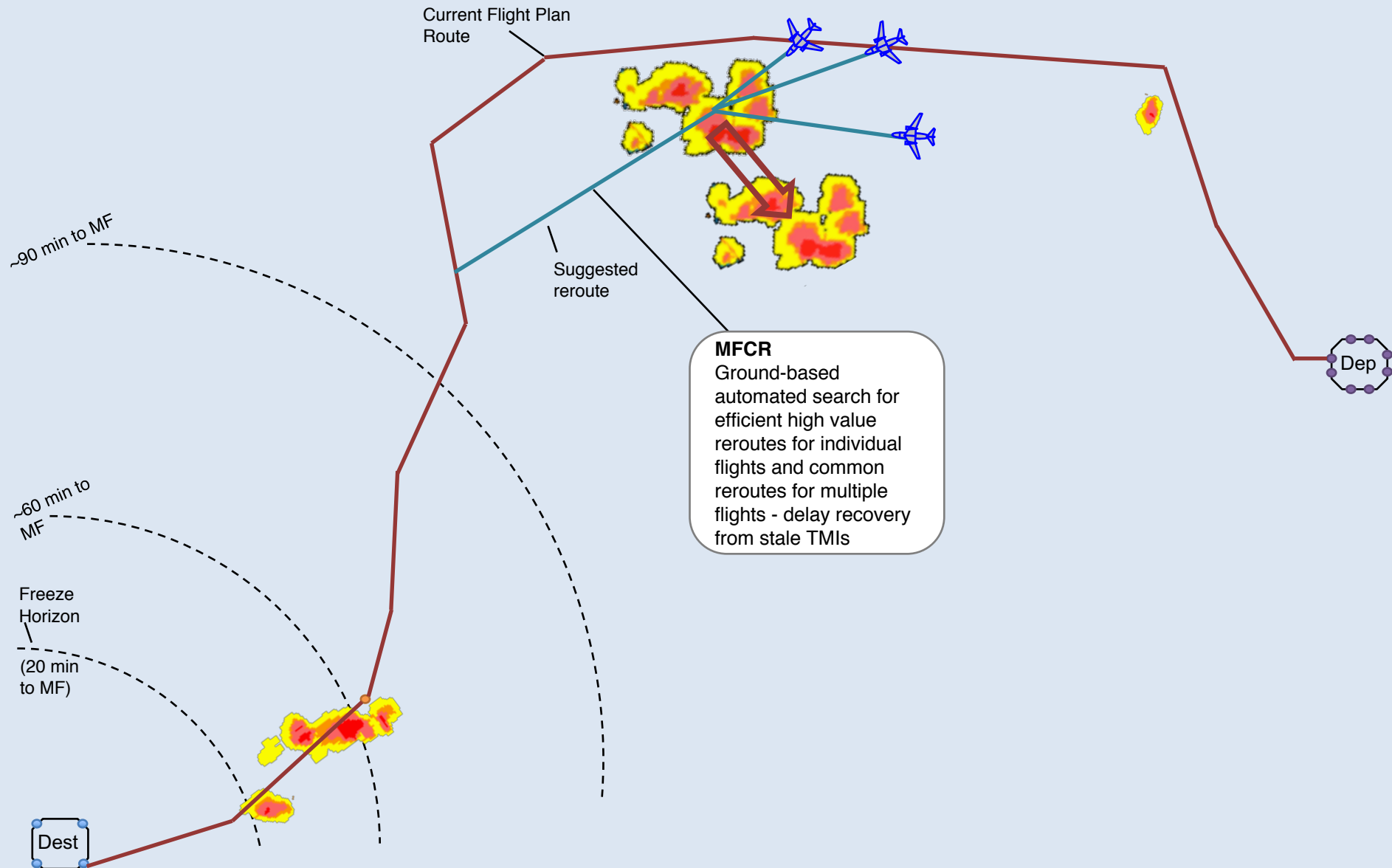


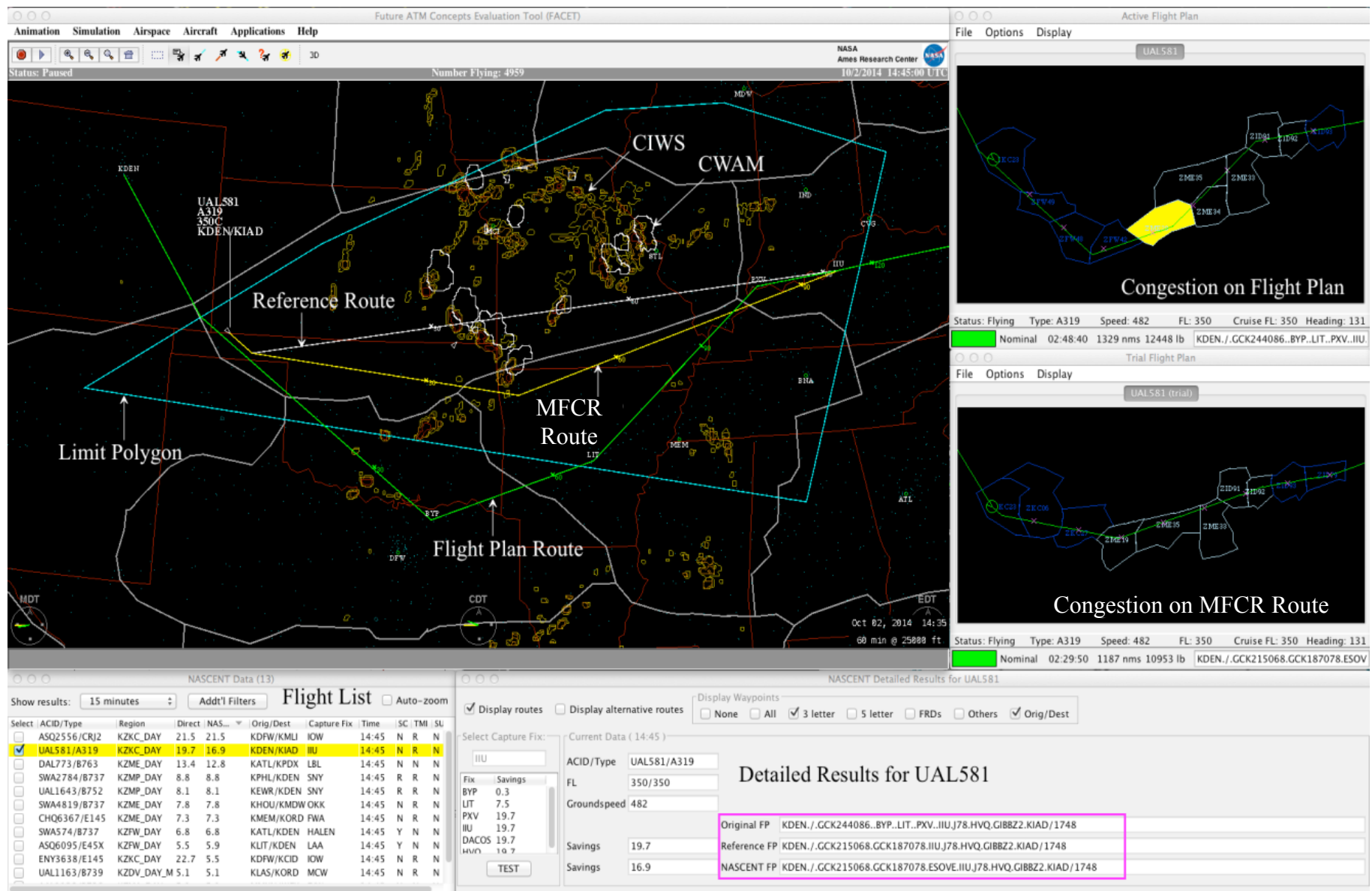
Dynamic Routes for Arrivals in Weather (DRAW):

Efficient reroutes to maintain metering operations in the presence of weather, find efficient arrival routes, and balance meter fix demand.



ATD-3 Integrated Concept

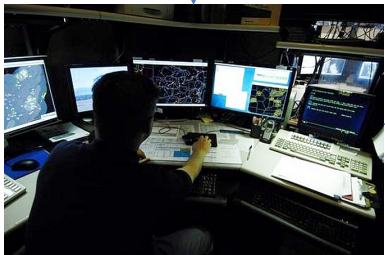




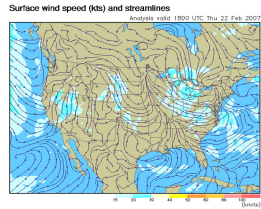
MFCR Architecture Diagram



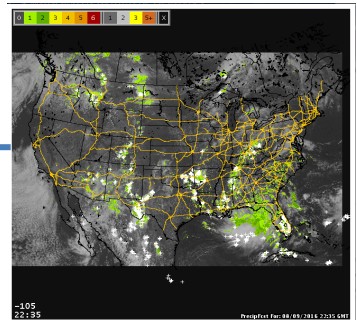
Dispatch or Traffic Management Coordinator



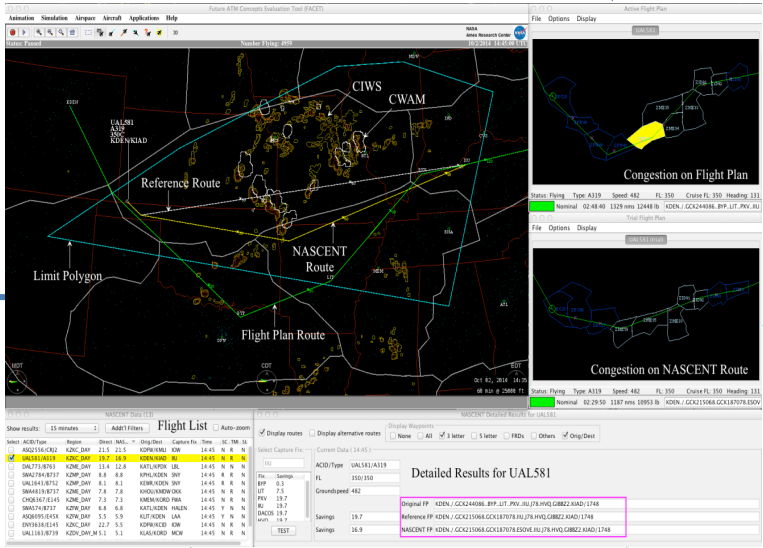
AOC or ARTCC



Rapid Refresh Wind Model (NOAA)



CIWS

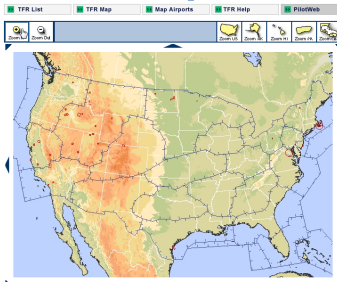


MFCR

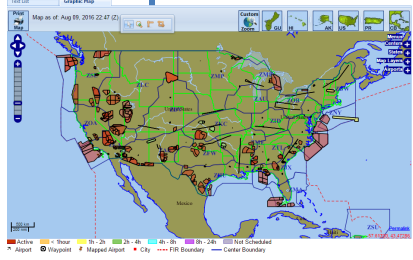


SWIM provides access to aviation information through a single connection.

TFM Data (via SWIM)

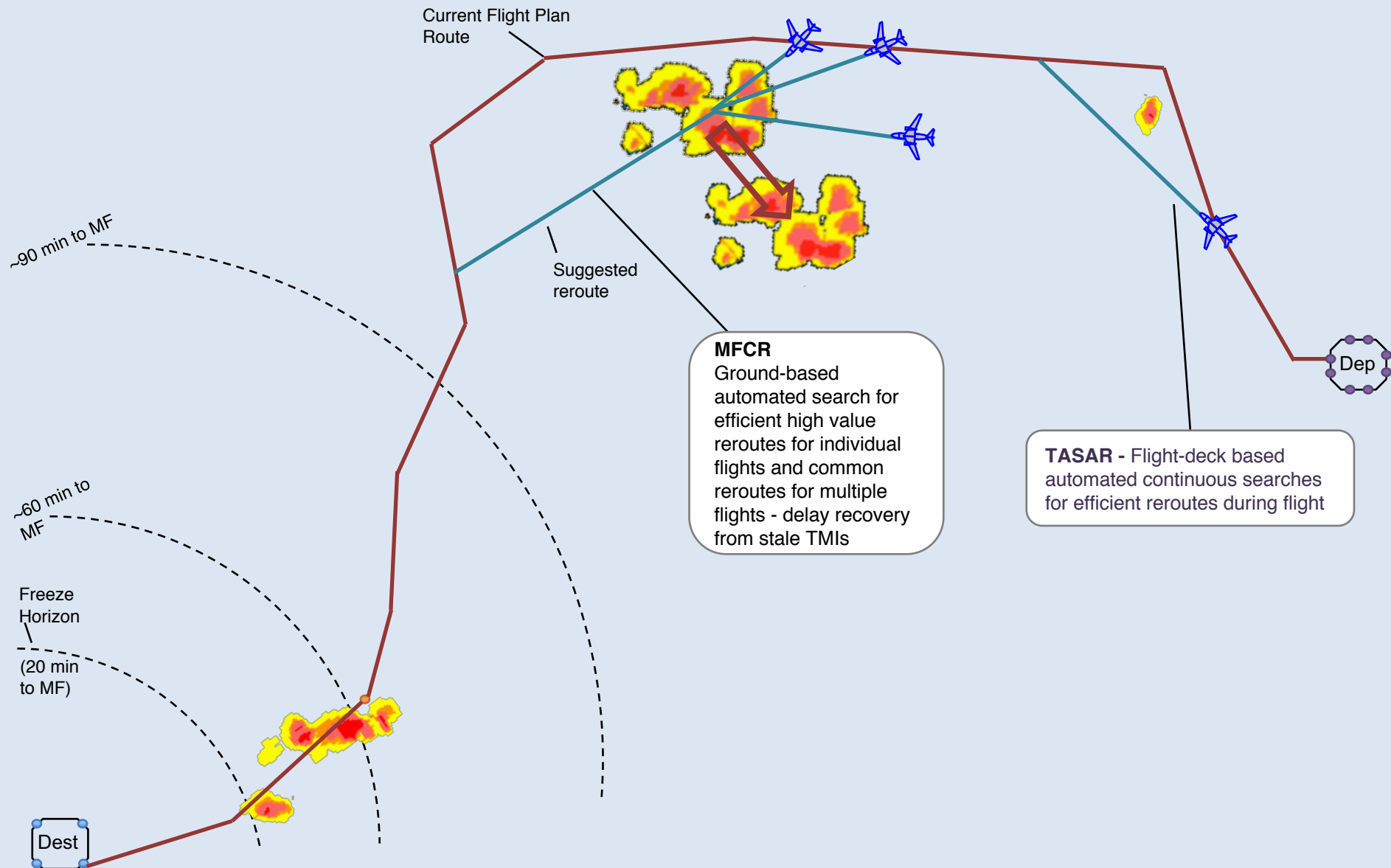
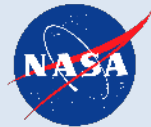


TFR System (FAA)

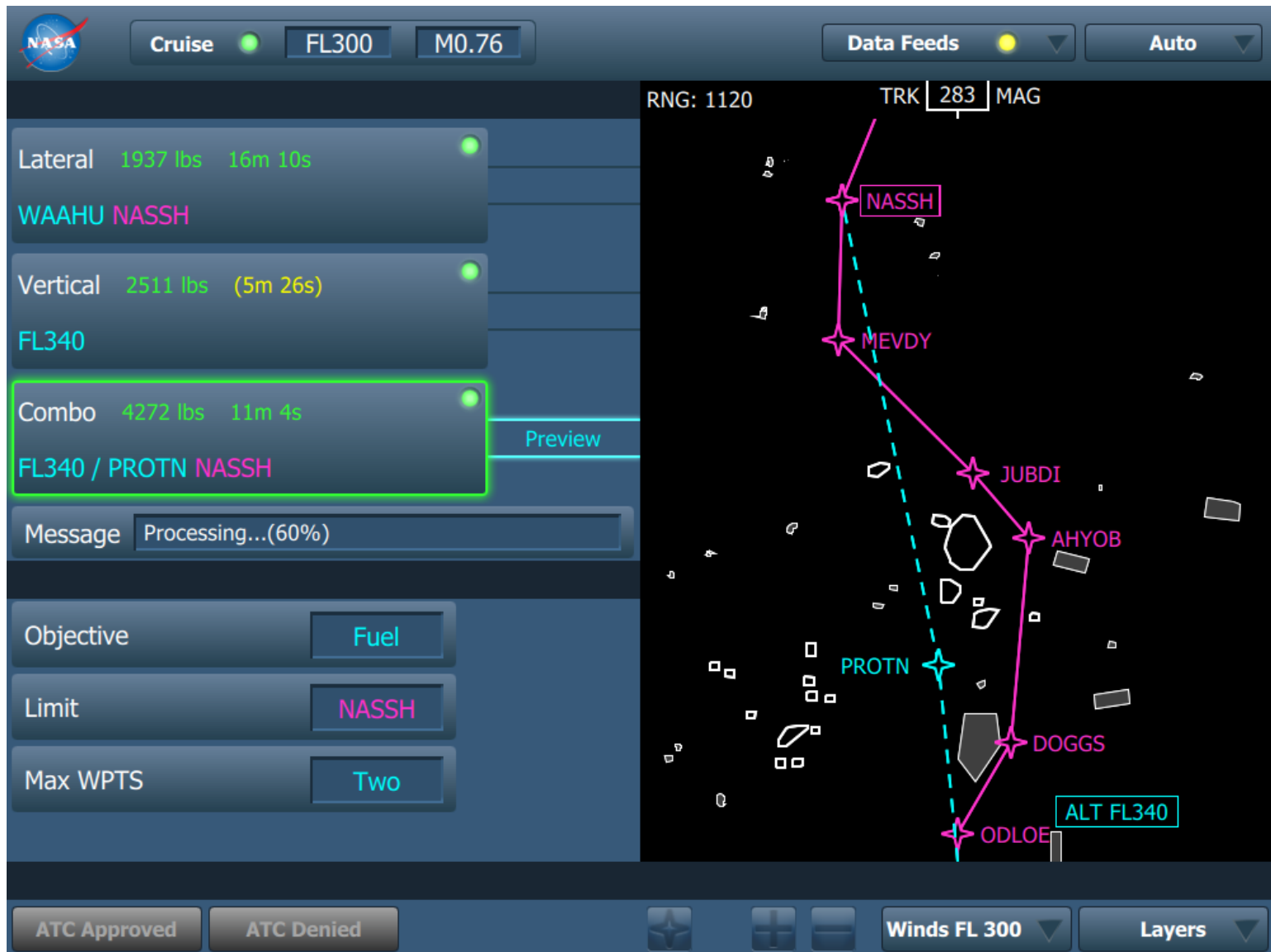
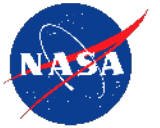


SUA System (FAA)

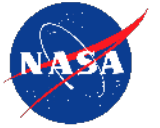
ATD-3 Integrated Concept



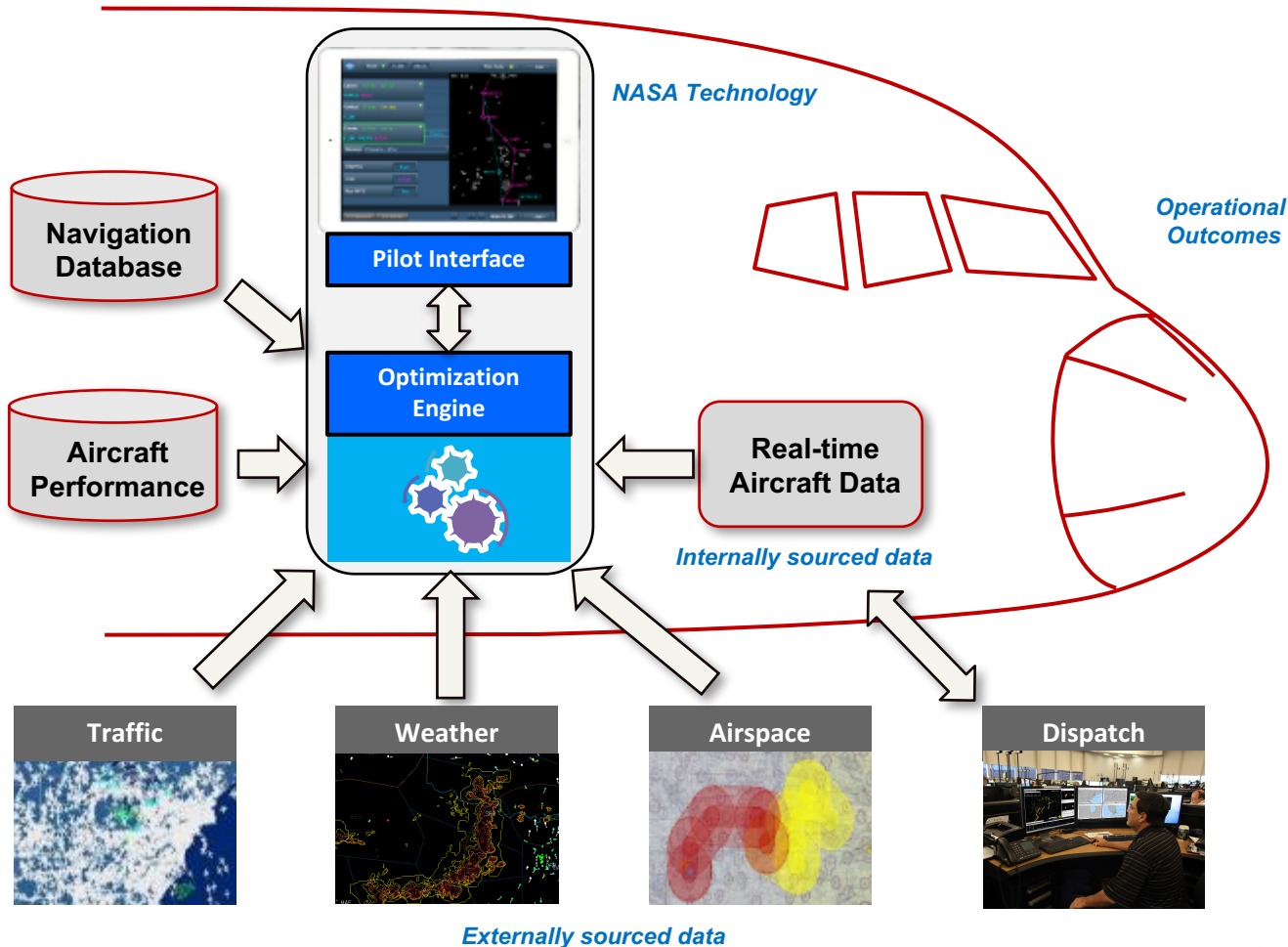
TASAR User Interface



Traffic Aware Strategic Aircrew Requests (TASAR)



Pilot uses onboard automation tool to optimize an aircraft's trajectory



Greater flight efficiency
en route



Crew Request

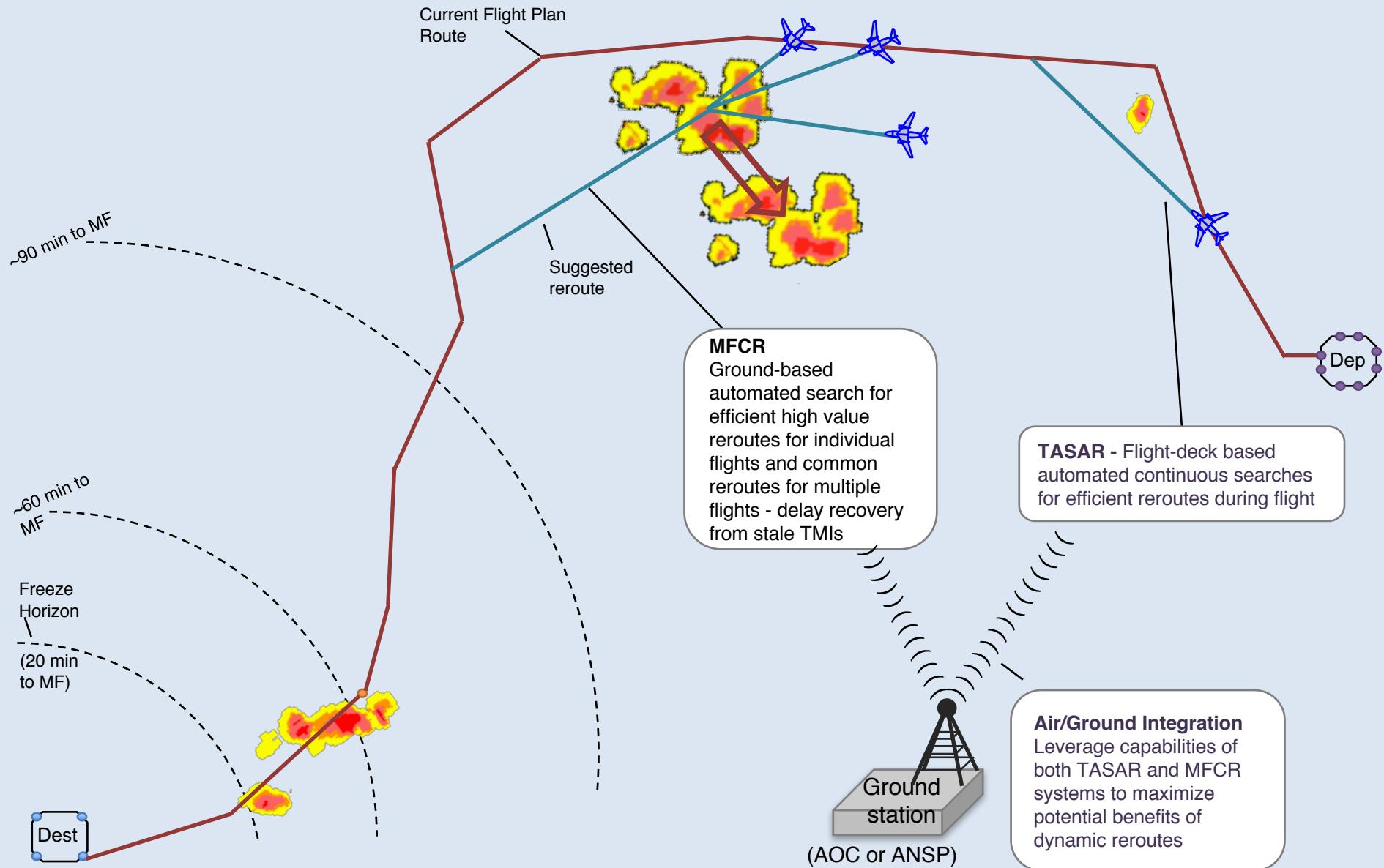
ATC Response



Increased ATC approval
of requests

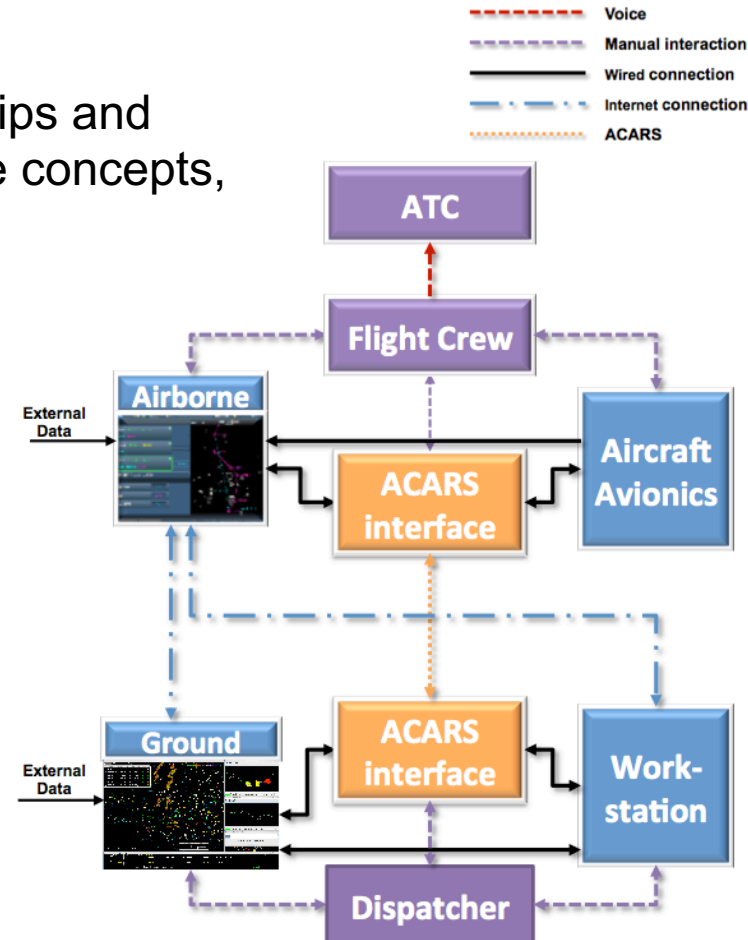
Tool leverages networked connectivity to real-time operational data

ATD-3 Integrated Concept

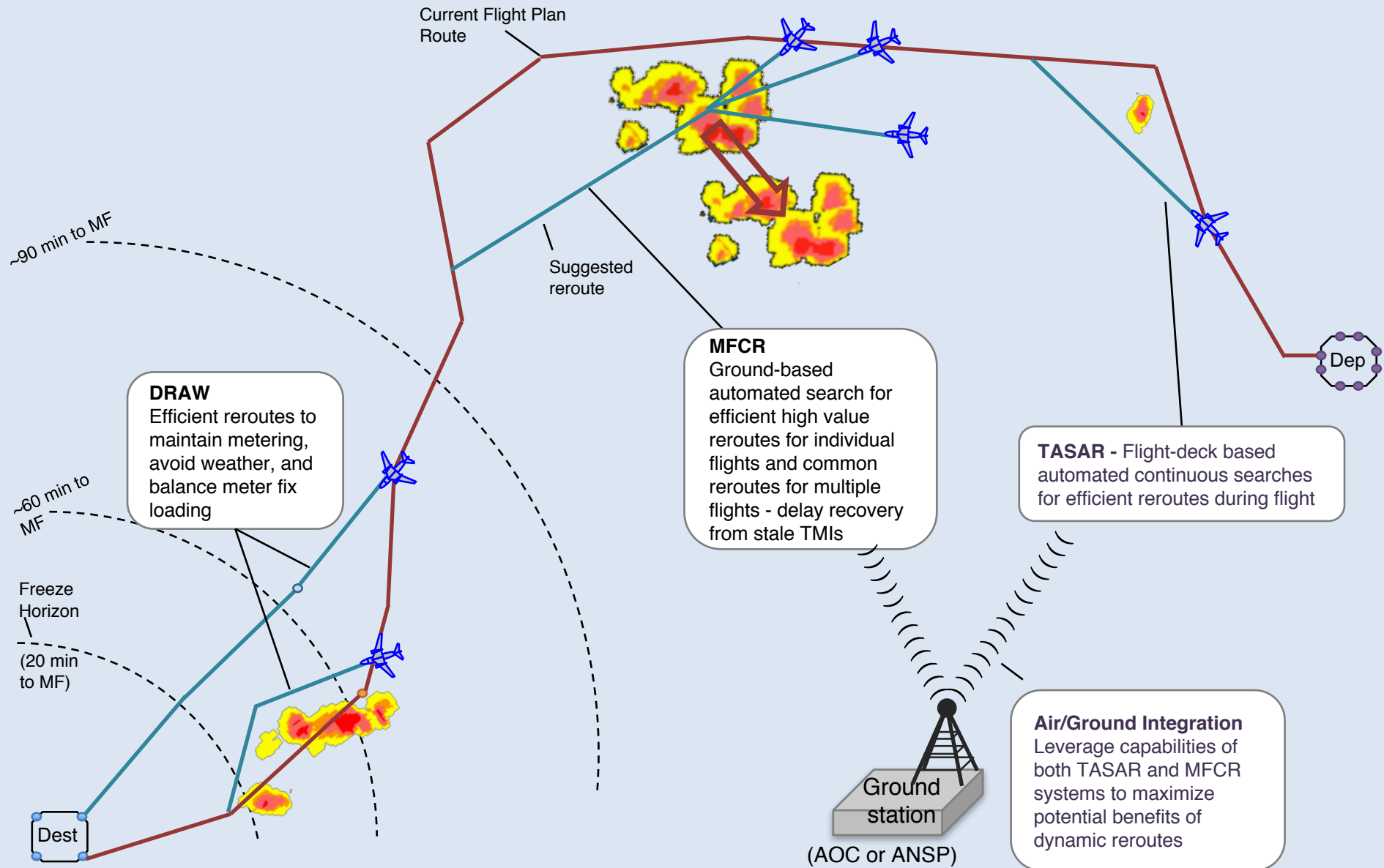


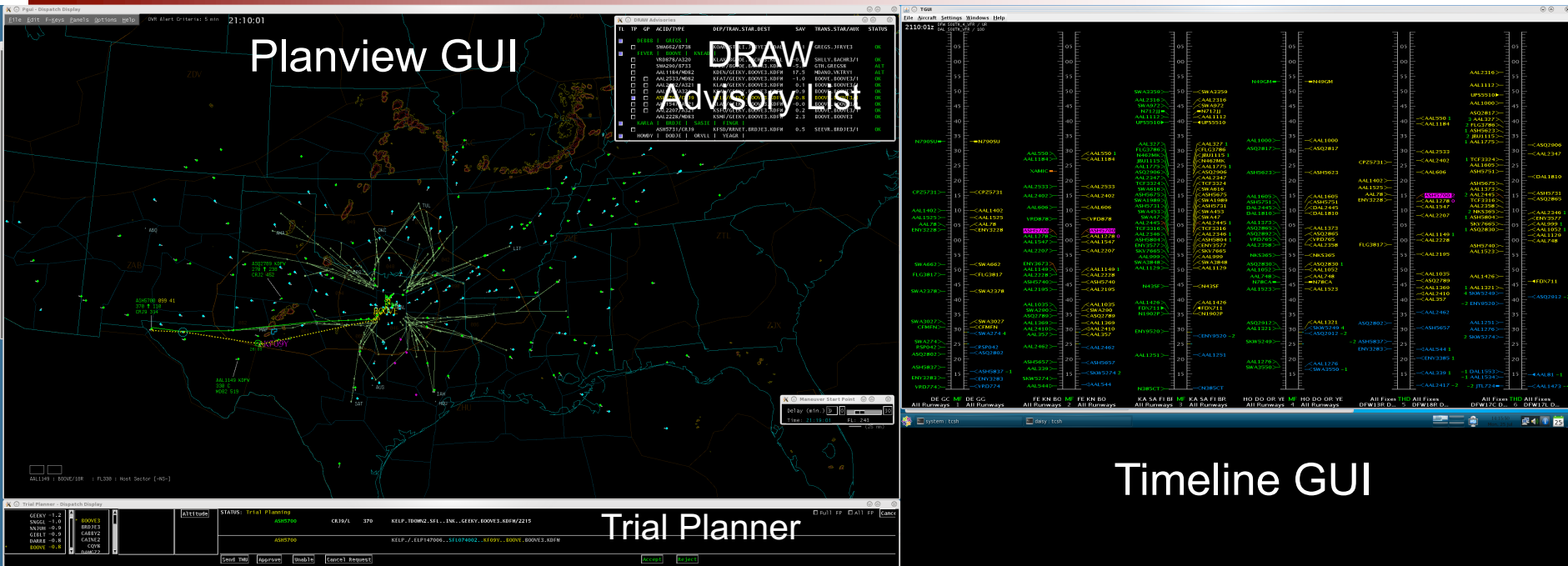
Plan through Q2FY17

- Qualitative benefit assessment of candidate air/ground concepts
- Leveraging existing airline and FAA partnerships and agreements, solicit feedback on top candidate concepts, establish demonstration partnership(s)
- Develop Objectives, initial ConOps, and top-level requirements for air/ground concept and demonstration
- Complete Air/Ground Integration Plan through FY20 leading to demonstration

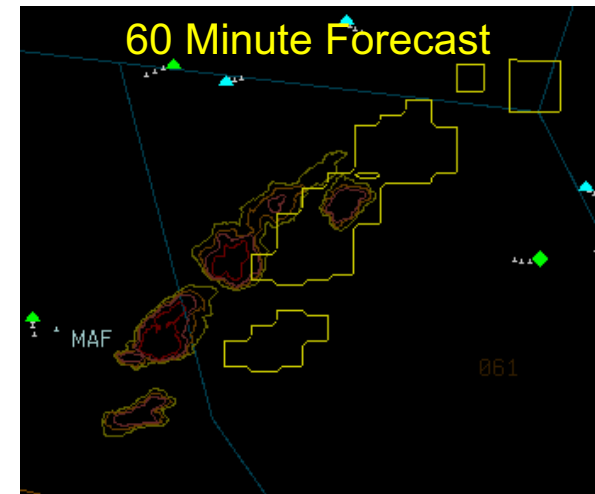
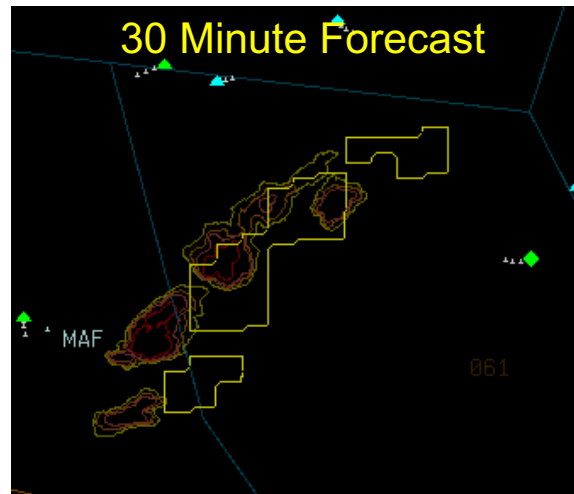
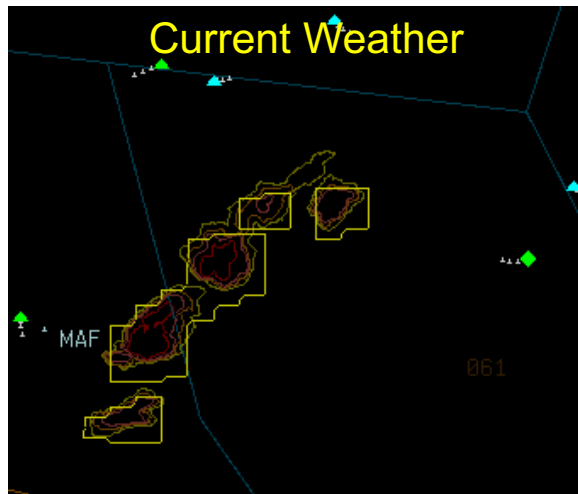
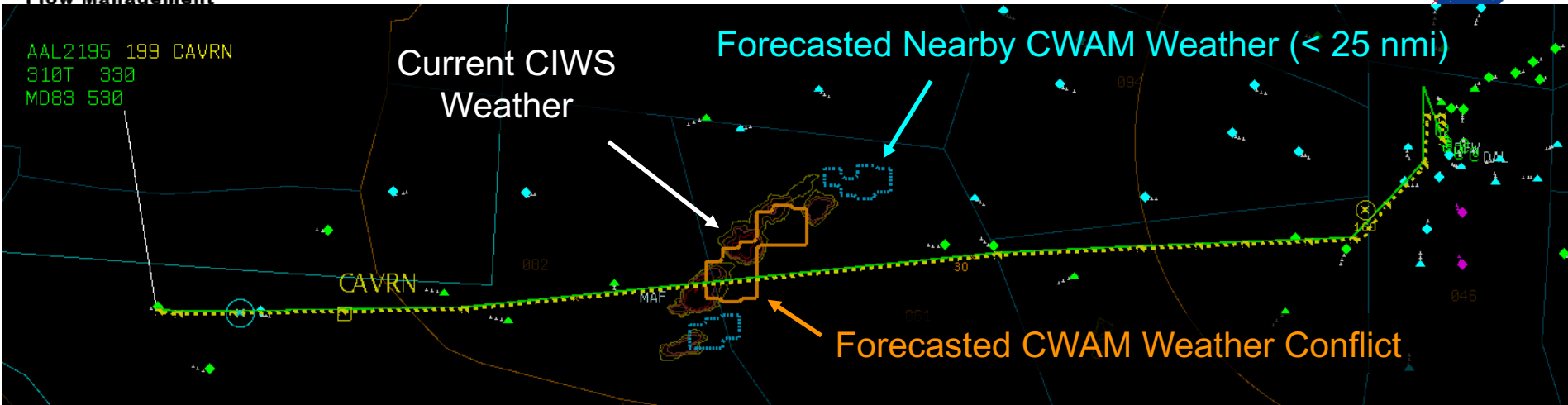


ATD-3 Integrated Concept



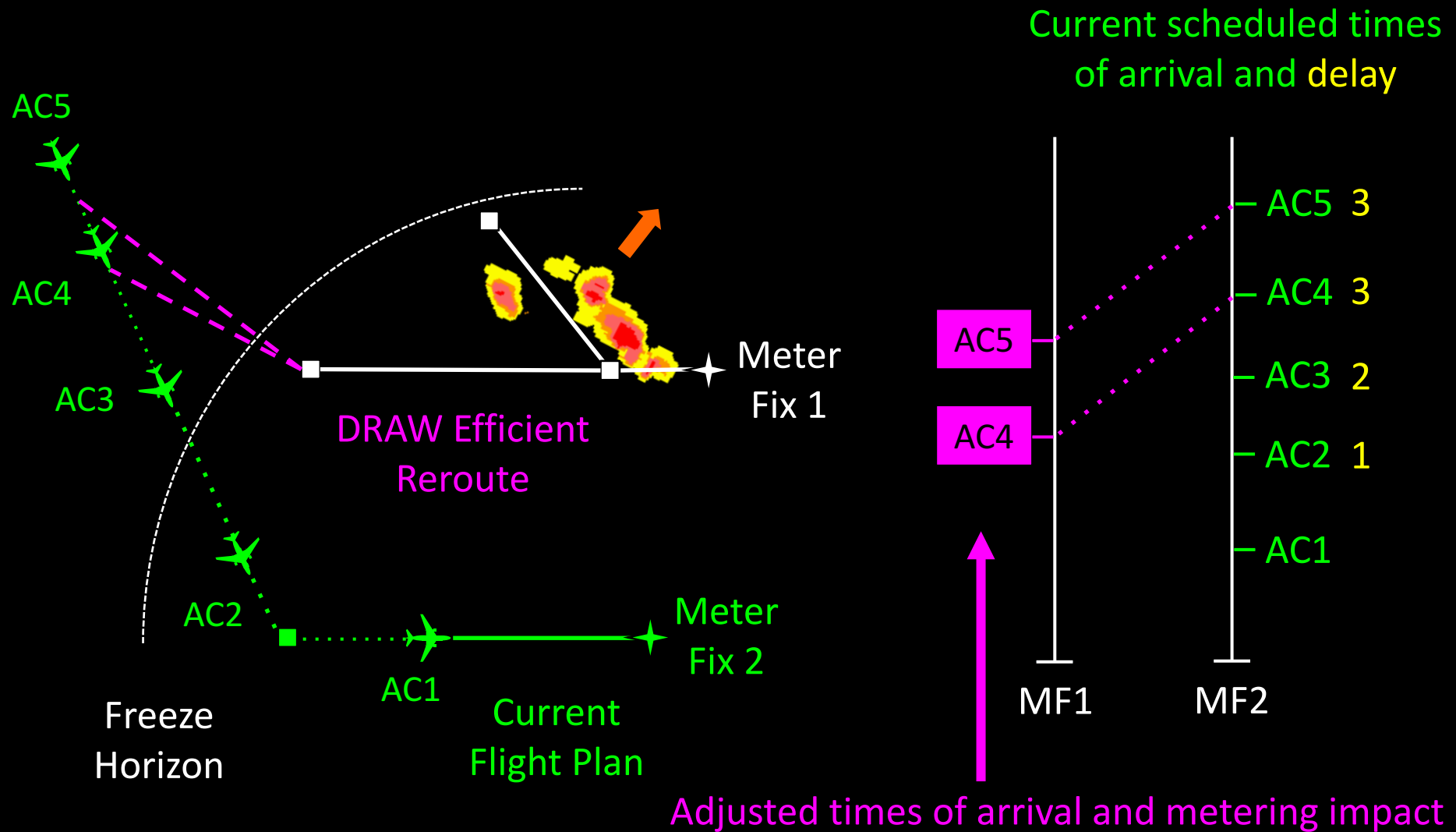


- Planned as future TBFM enhancement
- Integrated Route and Schedule Trial Planner
- Two-hour convective weather forecast updated every five minutes
- Hourly atmospheric updates (e.g., winds)
- ERAM traffic feed from home and adjacent Centers
- Reroute candidate automatically identified and posted on DRAW Advisory List

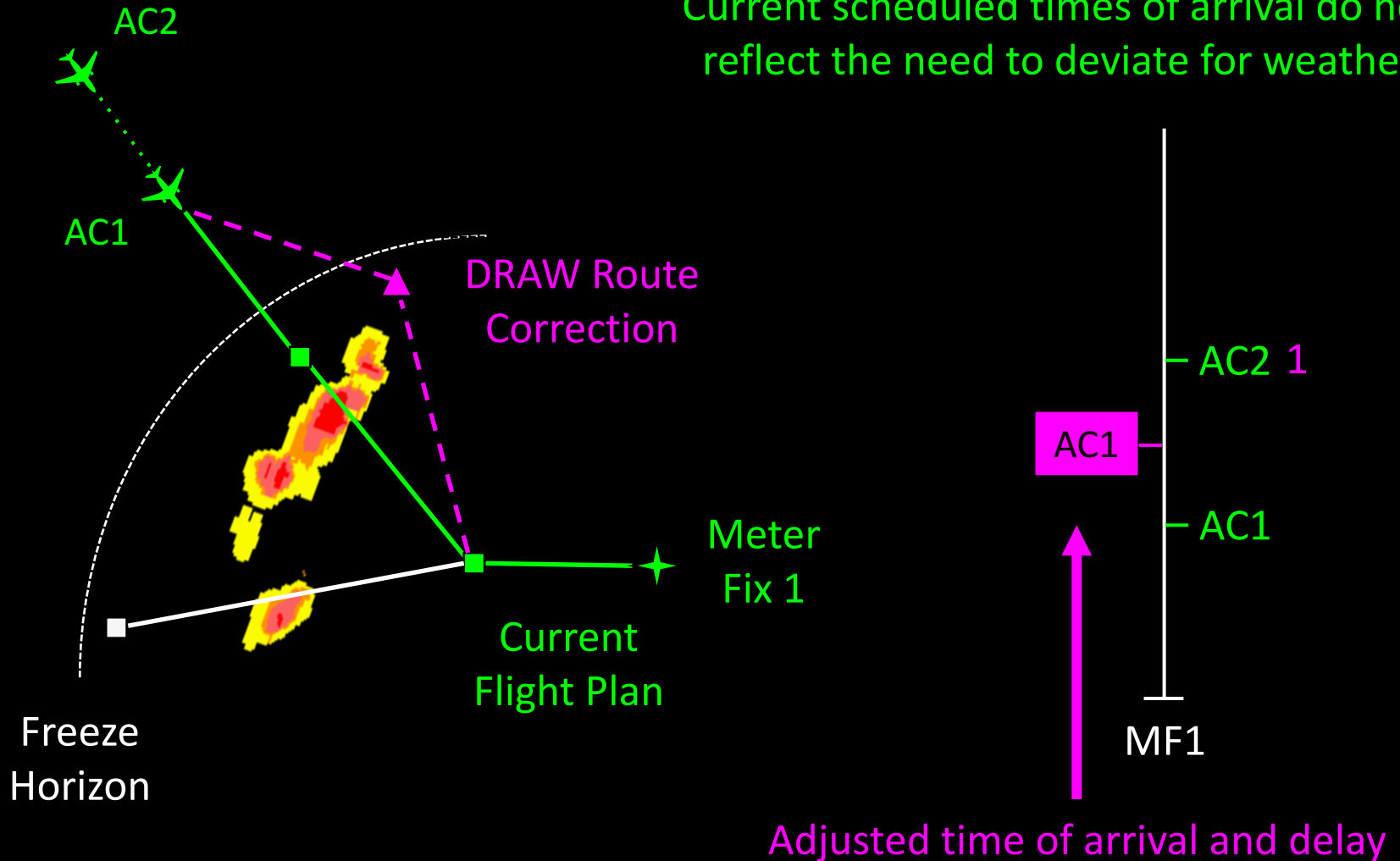


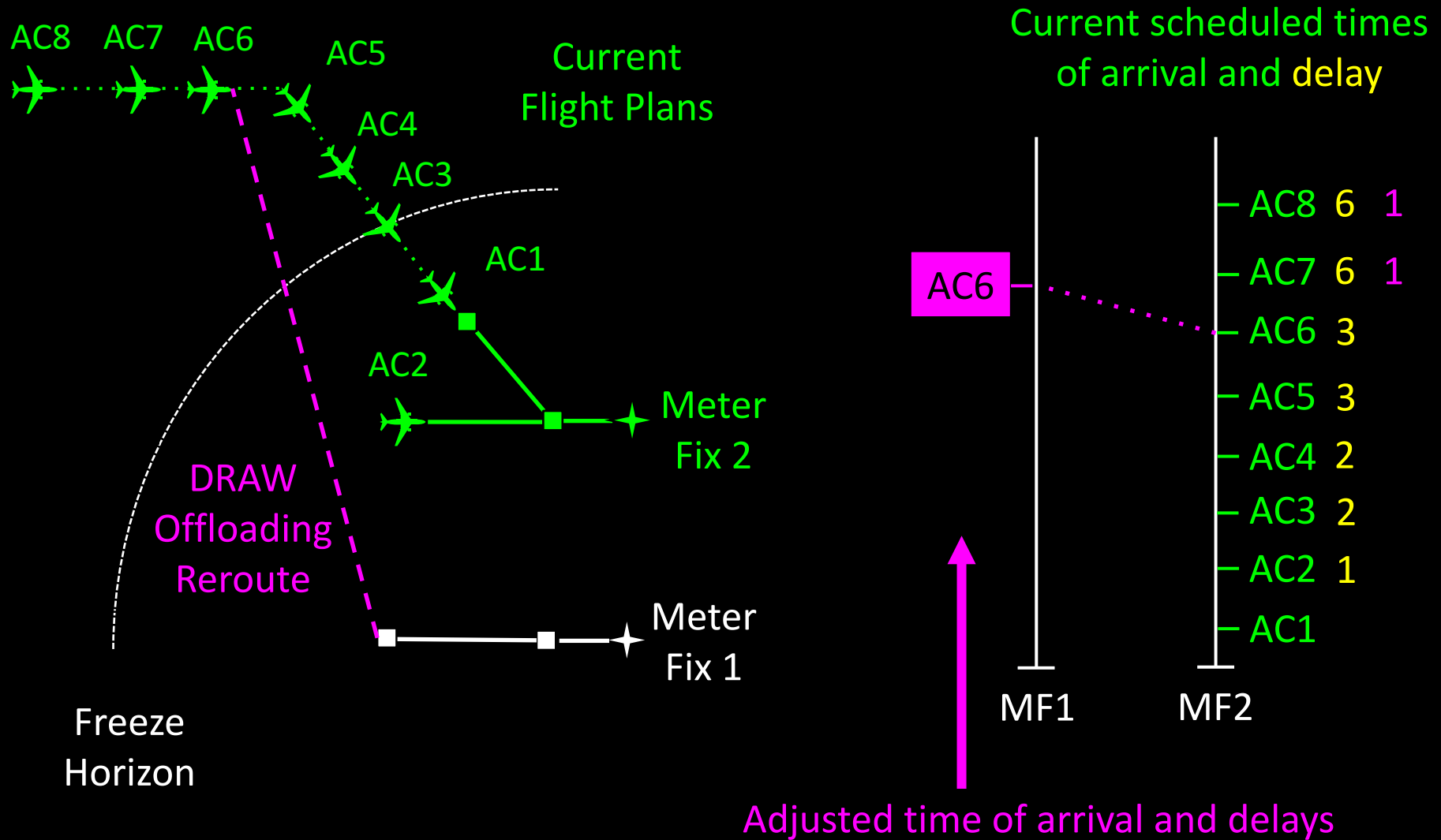
CIWS*: Corridor Integrated Weather System (precipitation, echo tops)

CWAM*: Convective Weather Avoidance Model (pilot deviation model)

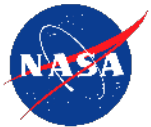


Current scheduled times of arrival do not reflect the need to deviate for weather





DRAW Advisory List



Individual Advisory Group Advisory Current Arrival Route Time Savings Proposed Arrival Route

Grouped By
Meter Fix

TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR.DEST	SAV	TRANS.STAR/AUX	STATUS
<input checked="" type="checkbox"/>			DEBBB GREGS				
	<input type="checkbox"/>		SWA662/B738	KOAK/STNLI.JFRYE3.KDAL	0.1	GREGS.JFRYE3	OK
<input checked="" type="checkbox"/>			FEVER BOOVE KNEAD				
	<input type="checkbox"/>		VRD878/A320	KLAX/BGTOE.BACHR3.KDAL	-0.8	KNEAD.BACHR3/1	OK
	<input type="checkbox"/>		SWA290/B733	KMAF/BGTOE.BACHR3.KDAL	0.2	ANGST.BACHR3	OK
	<input type="checkbox"/>		AAL1184/MD82	KDEN/GEEKY.BOOVE3.KDFW	17.5	MDANO.VKTRY1	ALT
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2533/MD82	KFAT/GEEKY.BOOVE3.KDFW	-1.0	BOOVE.BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2402/A321	KLAX/GEEKY.BOOVE3.KDFW	0.0	BOOVE.BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL606/A321	KSAN/GEEKY.BOOVE3.KDFW	-0.9	BOOVE.BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL1547/A321	KLAS/GEEKY.BOOVE3.KDFW	0.9	BOOVE.BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2207/A321	KSFO/GEEKY.BOOVE3.KDFW	2.3	BOOVE.BOOVE3/1	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2228/MD83	KSMF/GEEKY.BOOVE3.KDFW	1.6	BOOVE.BOOVE3	OK
	<input type="checkbox"/>	<input type="checkbox"/>	AAL2195/MD83	KTUS/GEEKY.BOOVE3.KDFW	-1.7	BOOVE.BOOVE3/1	OK
	<input type="checkbox"/>		ASQ2789/CRJ2	KMAF/GEEKY.BOOVE3.KDFW	-6.1	HNKER.VKTRY1	ALT
<input checked="" type="checkbox"/>			KARLA BRDJE SASIE FINGR				
<input checked="" type="checkbox"/>			HOWDY DODJE ORVLL YEAGR				

DRAW Status
OK: Weather Deviation Route
ALT: Alternate STAR

DRAW Integrated Route and Schedule Trial Planner



DRAW Trial Planning: Trial Plan Activation

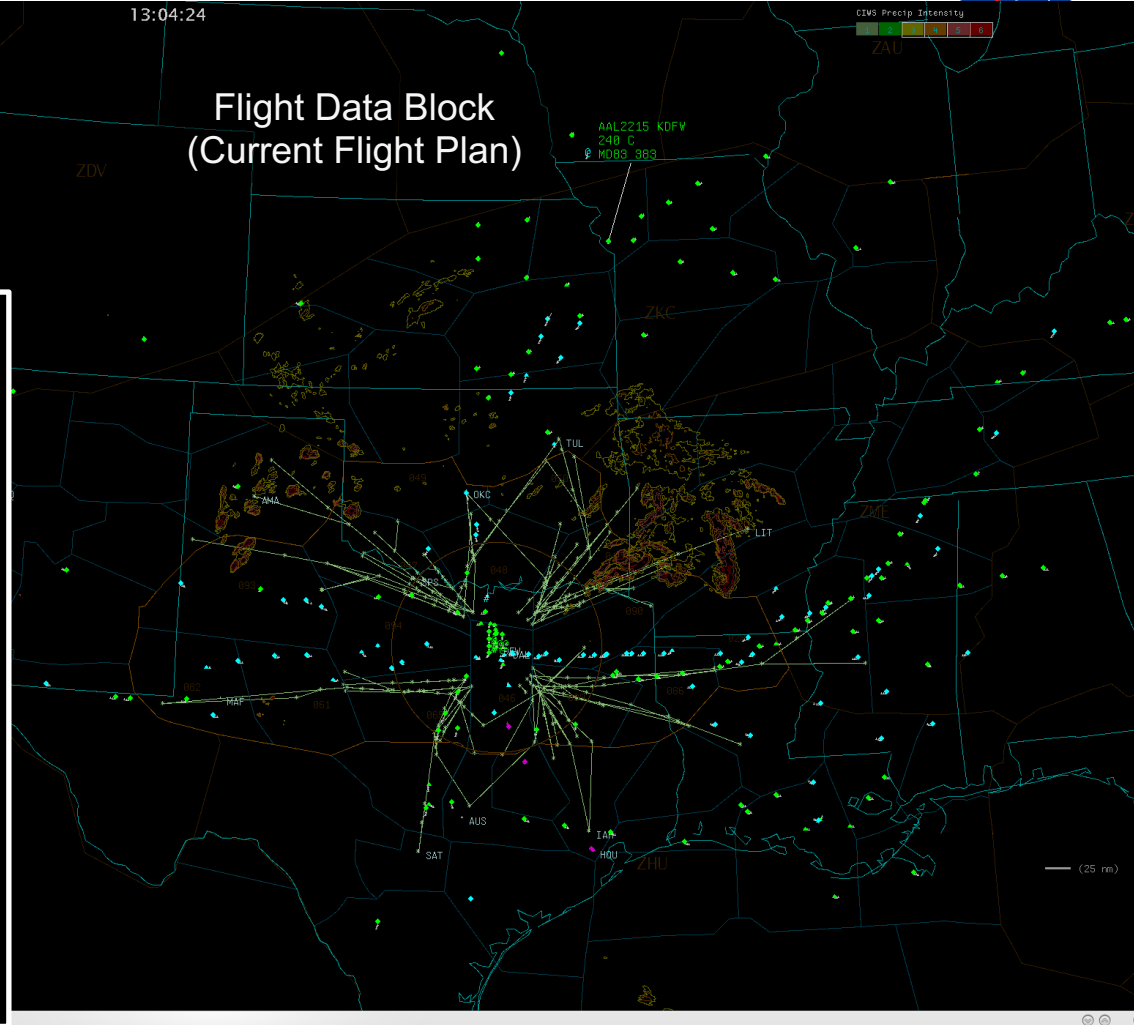
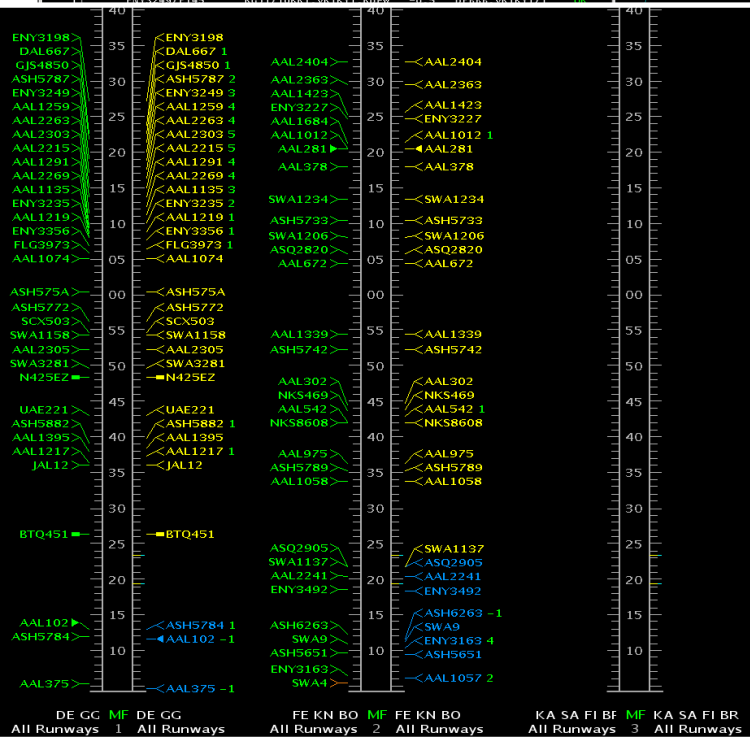


Applied Traffic

DRAW Advisories									
TL	TP	GP	ACID/TYPE	DEP/TRAN, STAR, DEST	SAV	TRANS, STAR/AUX	STATUS		
DEBBB 1 GREGS 1									
			SWA3281/B738	KMDW/HYDES, JFRV3, KDAL	7.5	AIRRF, CRTKT1	ALT		
			JAL12/B788	RJAA/MDANO, JOVME, KDFW	-9	AIRRF, CRTKT1	ALT		
			DAL667/A320	KMSP/HOFFF, VKTRY1, KDFW	6.8	AIRRF, CRTKT1	ALT		
			AAL1135/M083	KDMS/HOFFF, VKTRY1, KDFW	6.4	JONEZ, CAINE2	ALT		
			ENY3407/E145	KCMH/IBAKE, VKTRY1, KDFW	28.4	ASHEE, BROJ2	ALT		
			GJS4850/CR37	KORD/IBAKE, VKTRY1, KDFW	5.9	JONEZ, CAINE2	ALT		
			ASH5787/CR39	KSDF/IBAKE, VKTRY1, KDFW	5.9	JONEZ, CAINE2	ALT		
			AAL1259/M082	CYYZ/IBAKE, VKTRY1, KDFW	9.2	JONEZ, CAINE2	ALT		
			AAL2263/M083	KCMH/IBAKE, VKTRY1, KDFW	13.1	JONEZ, CAINE2	ALT		
			AAL2303/M082	KORD/IBAKE, VKTRY1, KDFW	5.9	JONEZ, CAINE2	ALT		
			AAL2215/M083	KDTH/IBAKE, VKTRY1, KDFW	8.5	JONEZ, CAINE2	ALT		
			ENY235/E145	RBM1/IBAKE, VKTRY1, KDFW	8.7	JONEZ, CAINE2	ALT		
			AAL1074/M083	KIND/IBAKE, VKTRY1, KDFW	11.9	JONEZ, CAINE2	ALT		
			AAL1219/M083	KSLC/MDANO, VKTRY1, KDFW	-1.3	DEBBB, VKTRY1/1	OK		
			ENY3677/E145	KPIA/POTTY, VKTRY1, KDFW	27.7	JONEZ, CAINE2	ALT		
			ENY3249/E145	KGTT/TURBT, VKTRY1, KDFW	20.5	DEBBB, VKTRY1/1	OK		

DRAW Advisory List

Flight Data Block
(Current Flight Plan)



Trial Planner Window



DRAW Trial Planning: Current Flight Plan



File Edit F-keys Panels Options Help

DVR Alert Criteria: 5 min

13:05:02

CWS Precip Intensity

DRAW Advisories

TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR.DEST	SAV	TRANS.STAR/AUX	STATUS
DEBBB I OREGS I							
<input type="checkbox"/>			SWA3281/B738	KMDW/HYDES J.FRYE3.KDAL	7.0	AIRRE.CRIKT1	ALT
<input type="checkbox"/>			JAL12/B788	RJAA/MDANO.JOVEM3.KDFW	0.0	ZUBOV.JOVEM3	OK
<input type="checkbox"/>			DAL667/A320	KMSP/HOFFF.VKTRY1.KDFW	6.5	JONEZ.CAINE2	ALT
<input type="checkbox"/>			ENY3407/E145	KCMH/IBAKE.VKTRY1.KDFW	28.3	AXMEE.BRDJE3	ALT
<input type="checkbox"/>			GJS4850/CRJ7	KORD/IBAKE.VKTRY1.KDFW	6.7	JONEZ.CAINE2	ALT
<input type="checkbox"/>			AAL2263/MD83	KCMH/IBAKE.VKTRY1.KDFW	12.9	JONEZ.CAINE2	ALT
<input type="checkbox"/>			AAL2303/MD82	KORD/IBAKE.VKTRY1.KDFW	5.7	JONEZ.CAINE2	ALT
<input type="checkbox"/>			AAL2215/MD83	KDTH/IBAKE.VKTRY1.KDFW	8.1	JONEZ.CAINE2	ALT
<input type="checkbox"/>			ENY3235/E145	KCMH/IBAKE.VKTRY1.KDFW	8.6	JONEZ.CAINE2	ALT
<input type="checkbox"/>			ENY3677/E145	KPIA/POTTY.VKTRY1.KDFW	27.5	JONEZ.CAINE2	ALT
<input type="checkbox"/>			ENY3249/E145	KGJT/TURKI.VKTRY1.KDFW	-1.9	TURKI.VKTRY1/1	OK
<input type="checkbox"/>			AAL2269/MD83	KCOS/TURKI.VKTRY1.KDFW	7.4	LAYMV.VKTRY1	OK
FEVER I KORE I KEND I							
<input type="checkbox"/>			KARLA	BRDJE	SASIE	FINGR	
<input type="checkbox"/>			HOMDY	DODJE	ORVLL	YEAGR	

Trial ETA, STA, Delay

DE CC	MF	DE CC	MF	FE KN BO	MF	FE KN BO	MF	KA SA FI BF	MF	KA SA FI BR	MF
All Runways 1 All Runways 2 All Runways 3 All Runways											

ENY3198>

DAL667>

GJS4850>

ASH5787>

ENY3249>

AAL1259>

AAL2263>

AAL2303>

AAL2215>

AAL1291>

AAL1135>

ENY3235>

AAL1219>

ENY3356>

AAL2269>

FLG3973>

AAL1074>

ASH575A>

ASH5772>

SCX503>

SWA1158>

AAL2305>

SWA3281>

N425E2>

UAE221>

ASH5882>

AAL1395>

AAL1217>

JAL12>

BTQ451>

AAL102>

ASH5784>

AAL975>

ENY3198

DAL667 1

GJS4850 1

ASH5787 2

ENY3249 4

AAL1259 4

AAL2263 4

AAL2303 5

AAL2215 6

AAL1291 5

AAL1135 4

ENY3235 3

AAL1219 2

ENY3356 2

AAL2269 2

FLG3973 1

AAL1074

ASH575A

ASH5772

SCX503

SWA1158

AAL2305

SWA3281

N425E2

UAE221

ASH5882 1

AAL1395

AAL1217 1

JAL12

BTQ451

ASH5784 1

AAL102 -1

ASH6263 -1

SWA9

ENY3163 4

ASH5651

AAL1057 2

AAL2404>

AAL2363>

ENY3227>

AAL1012>

AAL1423>

AAL1291>

SWA1234>

AAL281>

SWA1206>

AAL672>

ASQ2820>

AAL1339>

ASH5742>

AAL302>

NKS469>

NKS8608>

AAL542>

AAL975>

ASH5789>

AAL1058>

ASQ2905>

SWA1137>

AAL2241>

ENY3492>

ASH6263 -1

SWA9

ENY3163 4

ASH5651

AAL1057 2

AAL2404

AAL2363

ENY3227 1

AAL1012

AAL1423

AAL1291

SWA1234

AAL281

SWA1206

AAL672

ASQ2820

AAL1339

ASH5742

AAL302

NKS469

NKS8608

AAL542

AAL975

ASH5789

AAL1058

ASQ2905

SWA1137

AAL2241

ENY3492

ASH6263 -1

SWA9

ENY3163 4

ASH5651

AAL1057 2

Altitude

STATUS: Trial Planning

AAL2215 MD83/Z 240 KDTH./MC1051010..MC1..ICT..IRW..IBAKE.VKTRY1.KDFW

AAL2215 KDTH./ICT048160..ICT048141..ICT..IRW..IBAKE.VKTRY1.KDFW

Send TMU Approve Unable Cancel Request Accept Reject

Maneuver Start Point

Delay (min.): 0 30

Time: 13:08:02 EL: 240

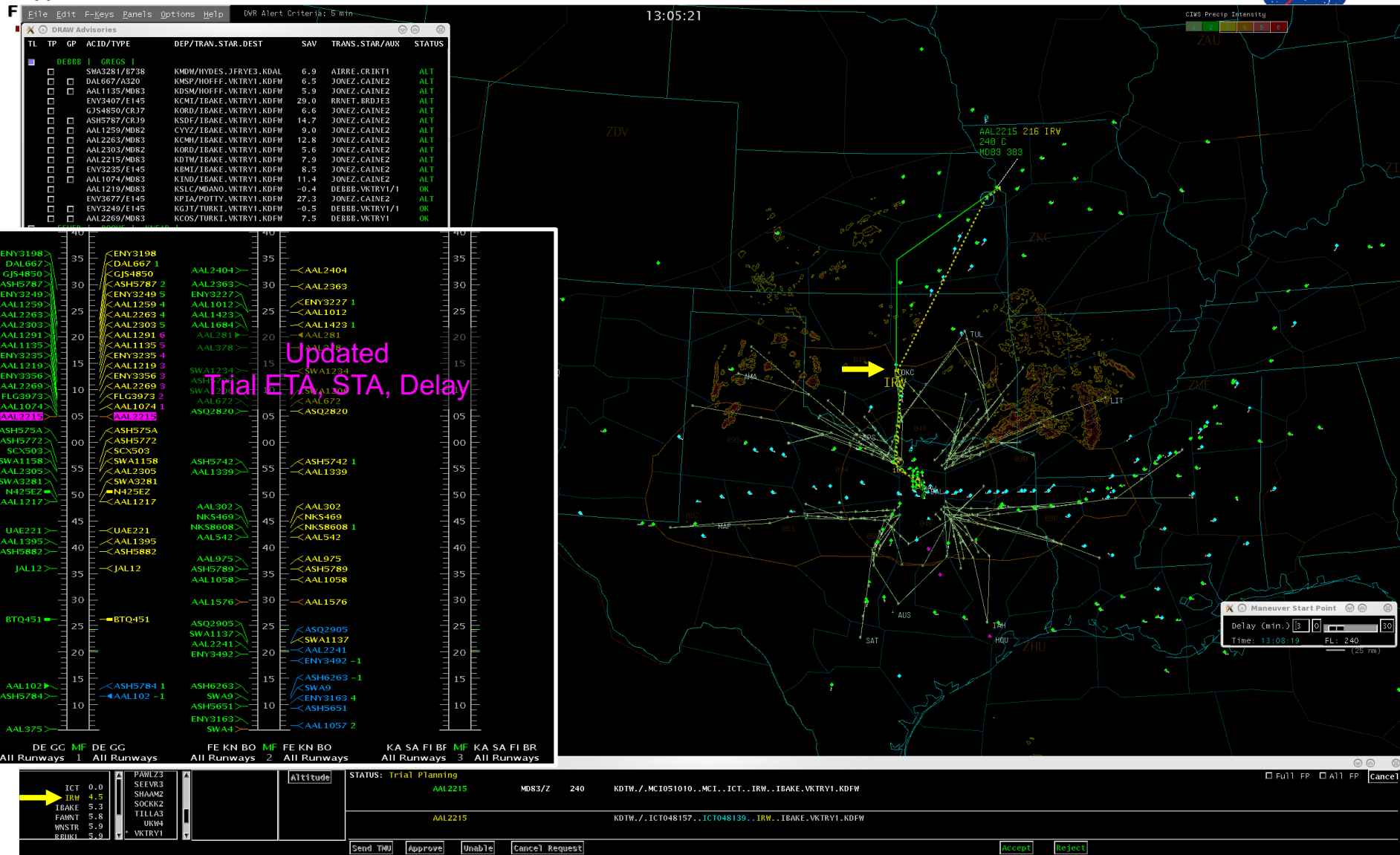
25 nm

Current Flight Plan Route

Trial Plan Route



DRAW Trial Planning: Capture Waypoint

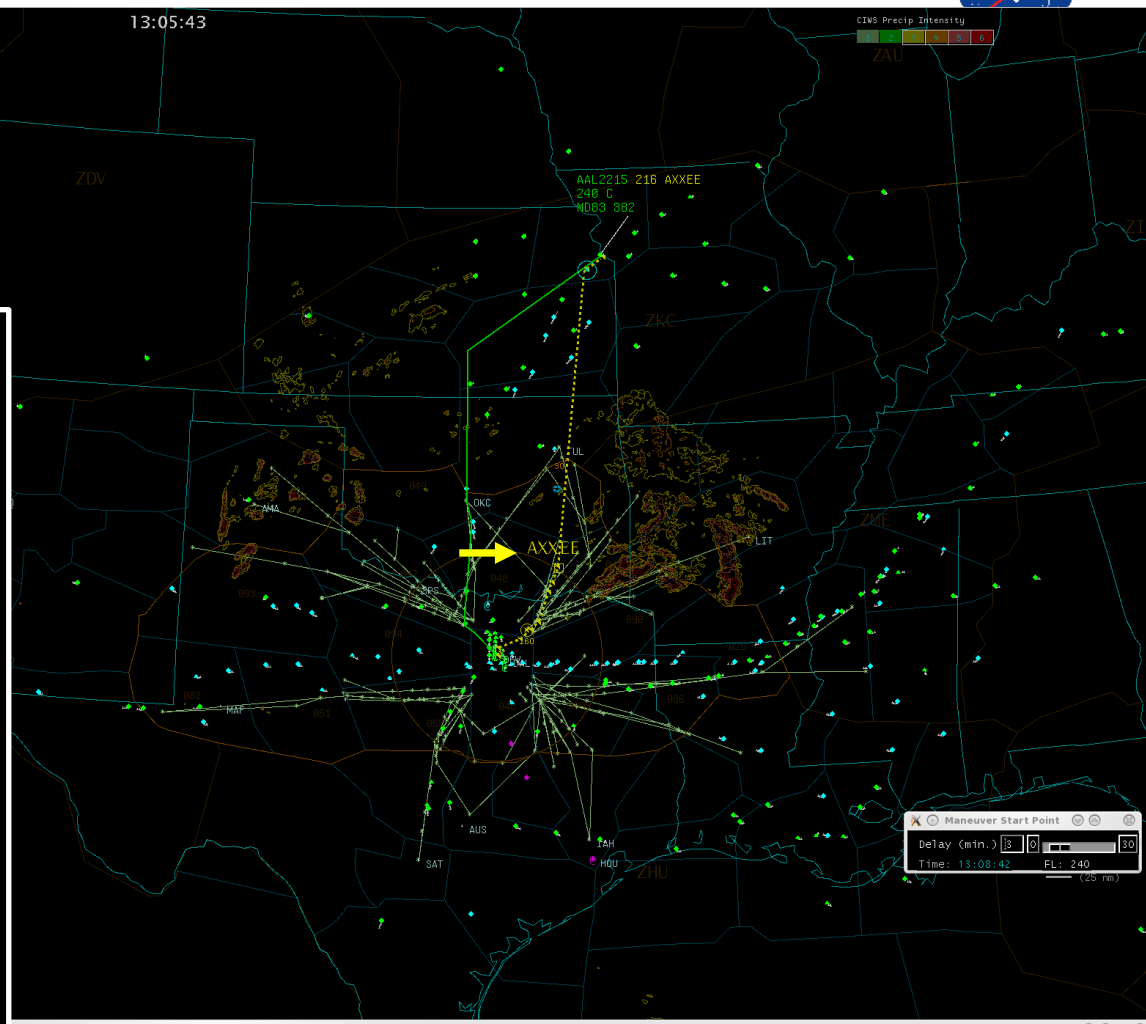
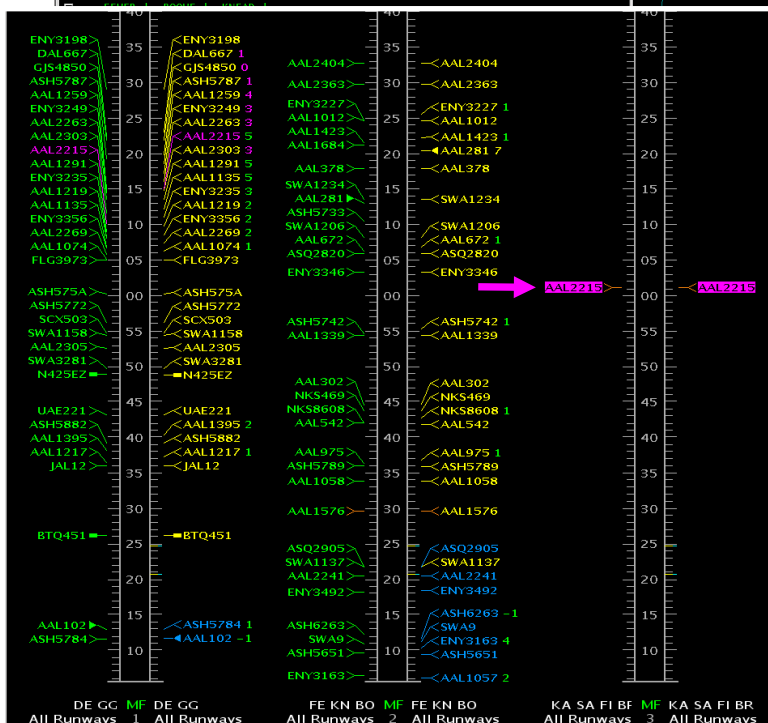


Capture Waypoints



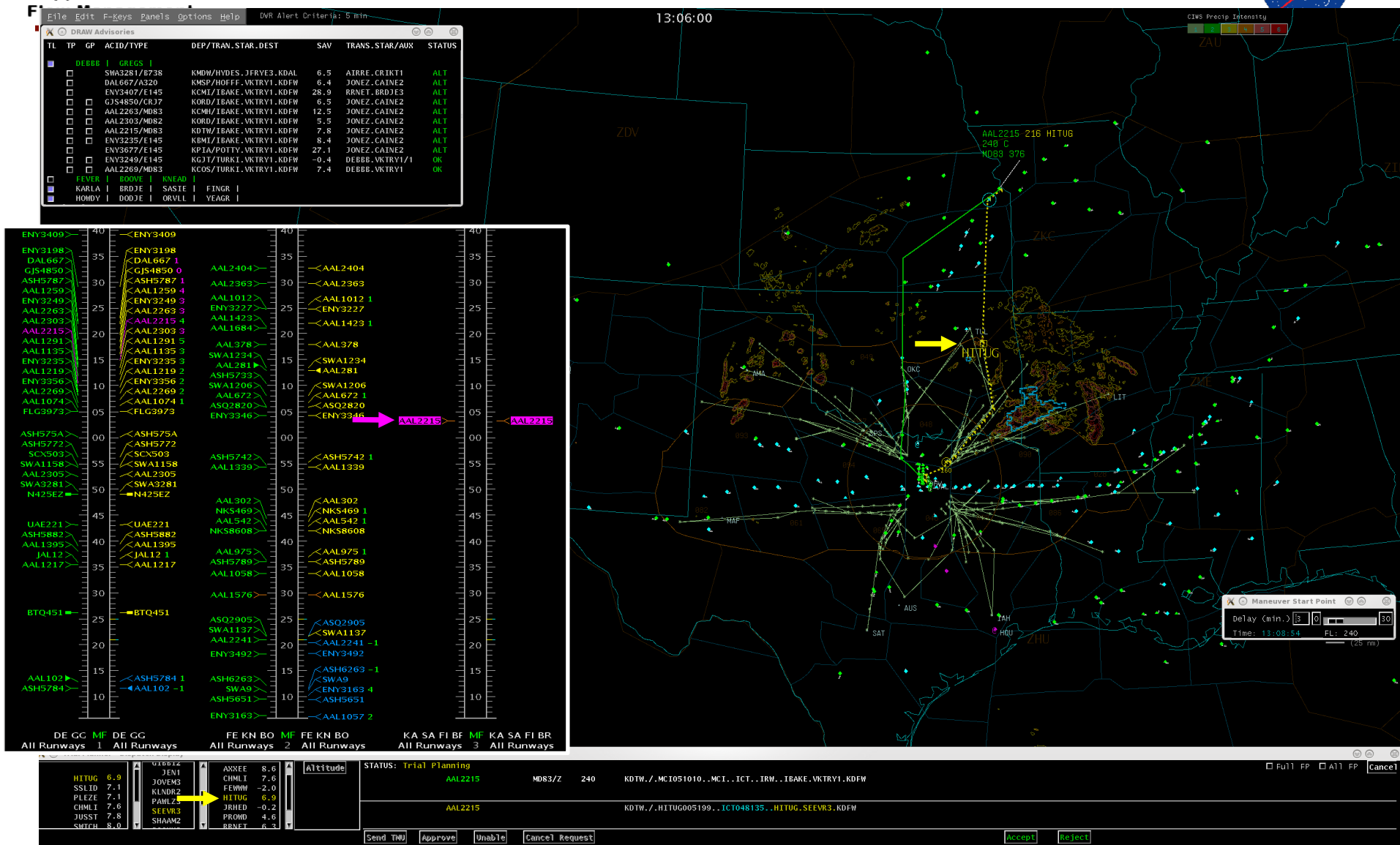
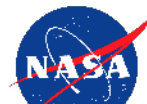
Applied Traffic

TL	GP	ACID/TY	DEF/TRAN	STAR_DEST	SAV	TRANS.STAR/AUX	STATUS
		DEBBB GREGS					
		SWA3281/8738	KMDW/HOYDES	JFRY33_KDAL	6.6	AJIREZ_CRIK11	ALT
		DAL667/A320	KMSP/HOFFE	VKTRY1_KDFW	6.4	JOENEZ_CAI2E	ALT
		AIL1135/M803	KOSM/HOFFE	VKTRY1_KDFW	5.8	JONEZ_CAI2E	ALT
		SWA404/E145	KCMJ/IBAKE	VKTRY1_KDFW	20.8	JOENEZ_CAI2E	ALT
		GJS4850/CRJ7	KORD/IBAKE	VKTRY1_KDFW	6.5	JONEZ_CAI2E	ALT
		ASH5787/CRJ9	KSDF/IBAKE	VKTRY1_KDFW	14.6	JONEZ_CAI2E	ALT
		AIL2599/M882	CYYZ/IBAKE	VKTRY1_KDFW	8.9	JONEZ_CAI2E	ALT
		AIL2263/M803	KCMH/IBAKE	VKTRY1_KDFW	12.7	JONEZ_CAI2E	ALT
		AIL2303/M882	KORD/IBAKE	VKTRY1_KDFW	5.5	JONEZ_CAI2E	ALT
		AIL2215/M803	KDTP/IBAKE	VKTRY1_KDFW	7.8	JONEZ_CAI2E	ALT
		ENY3235/E145	KBMT/IBAKE	VKTRY1_KDFW	8.4	JONEZ_CAI2E	ALT
		AIL1078/M883	KCMJ/IBAKE	VKTRY1_KDFW	11.2	JOENEZ_CAI2E	ALT
		AIL1219/M803	KSLC/MADON	VKTRY1_KDFW	-0.5	DEBBB_VKTRY1/I	OK
		ENY3677/E145	KPIA/POTTY	VKTRY1_KDFW	27.1	JONEZ_CAI2E	ALT
		ENY3249/E145	KGJT/TURKI	VKTRY1_KDFW	-0.5	DEBBB_VKTRY1/I	OK
		AIL2269/M883	KCOS/STRAT	VKTRY1_KDFW	7.4	DEBBB_VKTRY1	OK

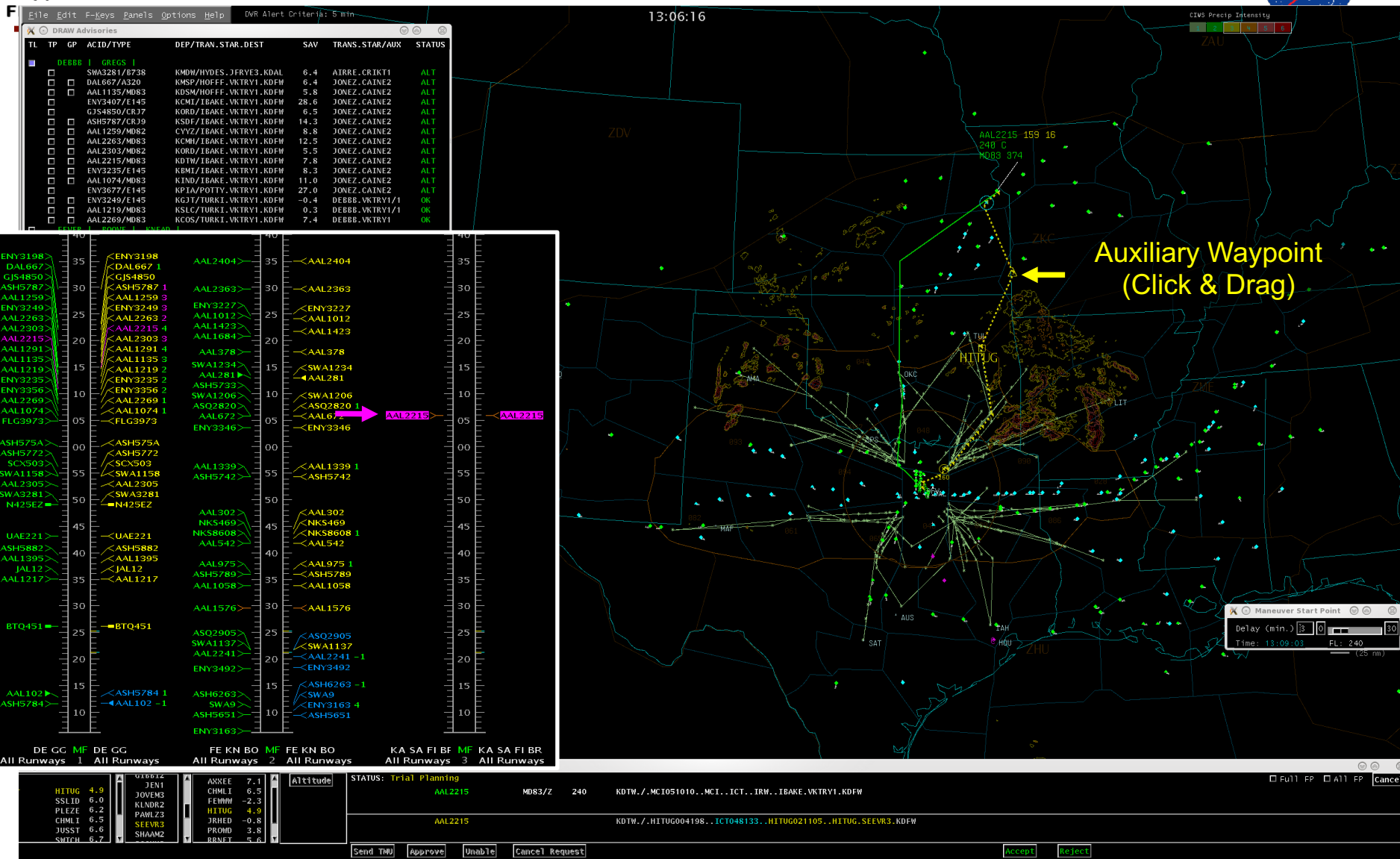


						Altitude		STATUS: Trial Planning		<input type="checkbox"/> Full FP <input type="checkbox"/> All FP <input type="button" value="Cancel"/>	
AXKEE	8.6	JEN1	AXKEE	8.6		AAL2215	MDS3/Z	240	KDTH./..MC1051010..MC1..ICT..IRW..IBAKE.VKTRY1.KDFW		
HMANV	8.6	JOVENR3	CHMLT	7.6							
LKINS	8.7	KLNDK2	FEDRW	-1.9							
SEEVN	8.7	PAWLZ3	HITUG	6.9		AAL2215			KDTH./..MC1232009..IC1048136..AXKEE.SEEVN3.KDFW		
BROJE	9.0	SEEVN3	JRHED	-0.2							
		SHAM2	PROMD	-4.6							
						Send TWU		Approve		Unable	
						Cancel Request				<input type="button" value="Accept"/> <input type="button" value="Reject"/>	

STARs

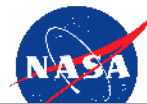


- Transition Fixes





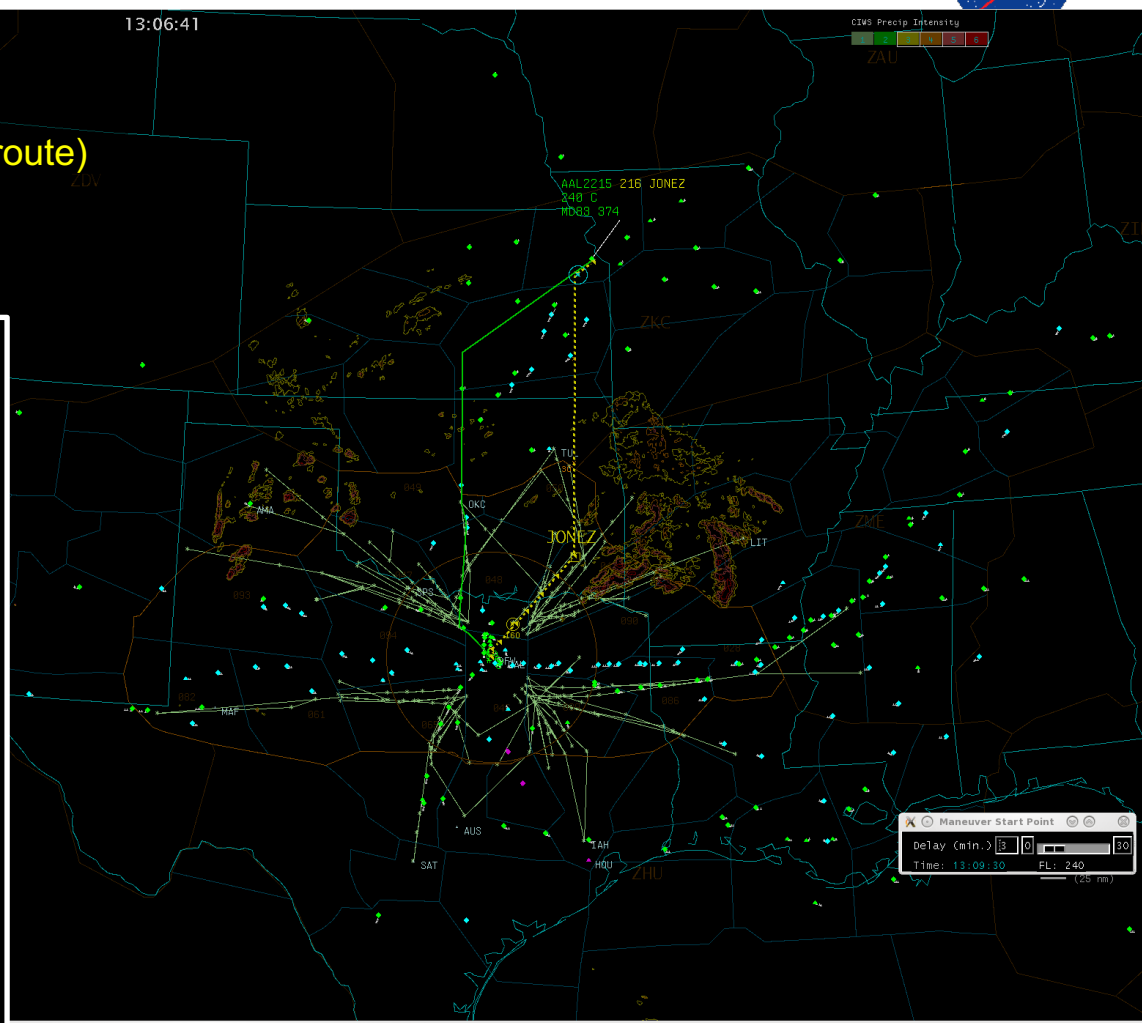
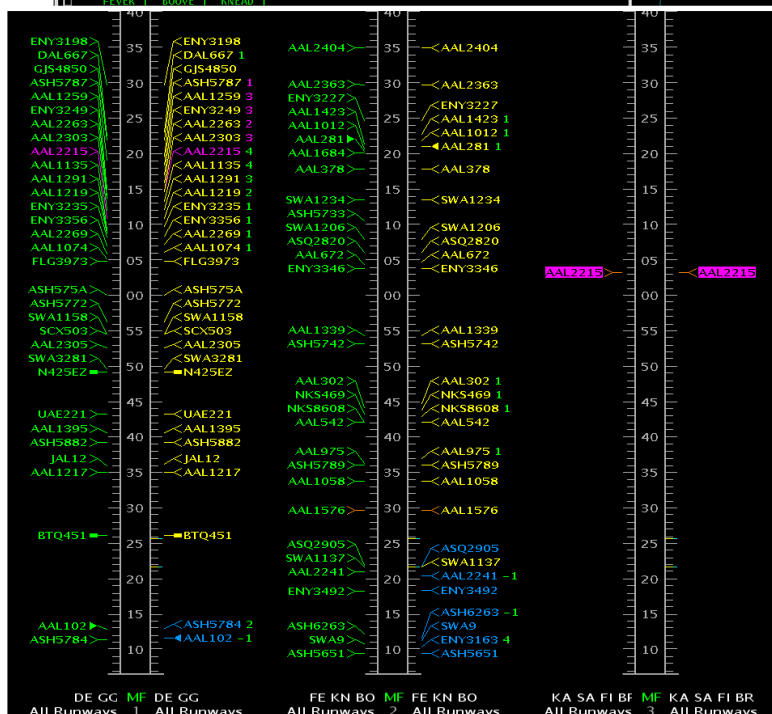
DRAW Trial Planning: DRAW List Activation



Applied Traffic

DRAW Advisories									
TL	TP	GP	ACID/TYPE	DEP/TRAN.STAR-DEST	SAV	TRANS.STAR/AUX	STATUS		
			DEBBB GREGS						
			SWA3281/B738	KMDW/HYDES..JRYE3..KDAL	6.2	AIRRE..CRINT1	ALT		
			DAL667/A320	KMSP/HOFFF..VKTRY1..KDFW	6.4	JONEZ..CAINE2	ALT		
			AAL1135/MD83	KDSM/HOFFF..VKTRY1..KDFW	5.8	JONEZ..CAINE2	ALT		
			ENV3407/MD83	ENY3407/IBAKE..VKTRY1..KDFW	5.6	JONEZ..CAINE2	ALT		
			GJS4850/MD83	GJS4850/IBAKE..VKTRY1..KDFW	5.8	JONEZ..CAINE2	ALT		
			ASH5787/MD83	ASH5787/IBAKE..VKTRY1..KDFW	5.8	JONEZ..CAINE2	ALT		
			AAL1259/MD82	CYYZ/IBAKE..VKTRY1..KDFW	8.8	JONEZ..CAINE2	ALT		
			AAL2263/MD83	KCMH/IBAKE..VKTRY1..KDFW	12.4	JONEZ..CAINE2	ALT		
			AAL2303/MD82	KORD/IBAKE..VKTRY1..KDFW	5.3	JONEZ..CAINE2	ALT		
			AAL2215/MD83	KDTW/IBAKE..VKTRY1..KDFW	7.7	JONEZ..CAINE2	ALT		
			ENV3235/E145	KBM1/IBAKE..VKTRY1..KDFW	8.3	JONEZ..CAINE2	ALT		
			AAL1074/MD83	KIND/IBAKE..VKTRY1..KDFW	11.0	JONEZ..CAINE2	ALT		
			ENV3677/E145	KPIA/POTTY..VKTRY1..KDFW	26.8	JONEZ..CAINE2	ALT		
			ENV3249/E145	KGJT/TURKI..VKTRY1..KDFW	-0.4	DEBBB..VKTRY1/I	OK		
			AAL1219/MD83	KSLG/TURKI..VKTRY1..KDFW	0.3	DEBBB..VKTRY1/I	OK		
			AAL2269/MD83	KCOS/TURKI..VKTRY1..KDFW	7.3	DEBBB..VKTRY1	OK		
			FEVER ROOFV KNEA0						

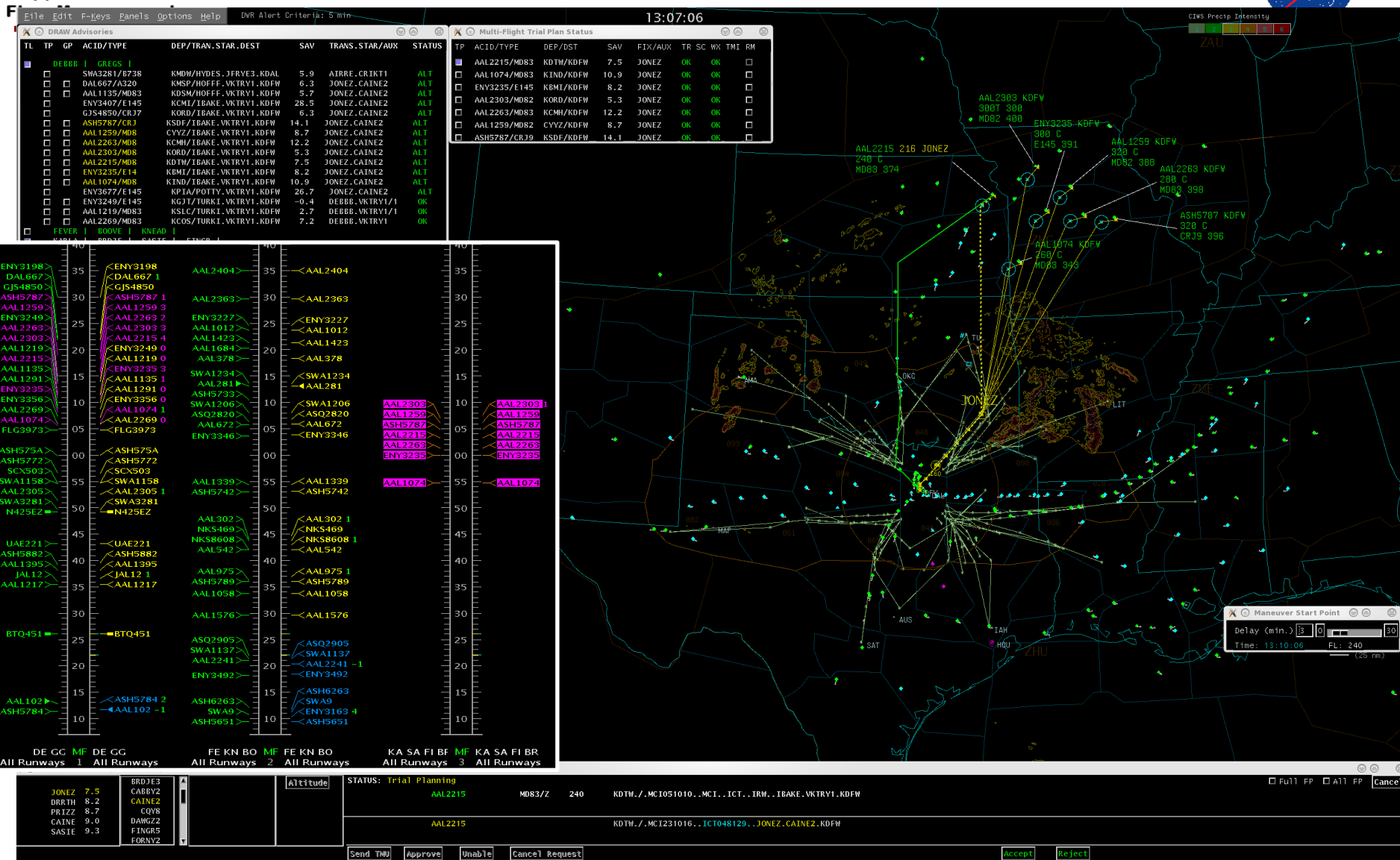
DRAW List Activation (pre-defined route)



DE GG MF DE GG	FE KN BO MF FE KN BO	KA SA FI BF MF KA SA FI BR
All Runways 1 All Runways	All Runways 2 All Runways	All Runways 3 All Runways

JONEZ 7.7	BRDJE3	Altitude	STATUS: Trial Planning
DRRTH 8.4	CABBY2		AAL2215 MD83/Z 240 KDTW../MC1051010..MCI..ICT..IRW..IBAKE..VKTRY1..KDFW
PRIZZ 8.8	COY8		
CAINE 9.2	DANQ22		AAL2215 KDTW../MC1232012..ICT048132..JONEZ..CAINE2..KDFW
SASIE 9.4	FINGR5		
	FORNV2		

Buttons: Send TRU, Approve, Unable, Cancel Request, Accept, Reject



Questions

Chester.Gong@nasa.gov